Fullenwider

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EFFECT OF SOAP AND ALUM WASHES ON THE ABSORPTIVE POWER OF MASONRY

BY

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THESIS FOR DEGREE OF BACHELOR OF SCIENCE
IN CIVIL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS
PRESENTED JUNE 1902

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May 29 1902

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OF Bachelor of Science in Civil Engineering

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Effect of Soap and Alum Washes on the Absorptive Power of Masonry.

In Baker's "Masonry Construction", the author when describing the method of making mortar impervious to water, recommends potash soap in preference to soda soap. Later when speaking of making brick masonry impervious to water, he illustrates the method by quoting W. S. Dearborn's experience with the new Croton reservoir in New York City. Dearborn used Castile soap which is a soda soap. The fact that potash soap is recommended in one place, and that in another place an instance is cited where soda soap was successfully used, together with the following incident led the writer to investigate the relative merits of the two soaps.

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The incident is as follows: Professor Baker received a letter from an engineer in Minneapolis, who had vainly attempted to make a reservoir waterproof by the methods recommended in Baker's "Masonry Construction". In the letter Professor Baker was very severely criticised for recommending a method that led to failure. He then wrote the engineer asking whether he had not used soda soap instead of potash soap. He did not receive an immediate reply, but some time later got a letter from the engineer in which he apologized for his former criticism, and which was accompanied by a letter from the soap manufacturers stating that they had sent a soda instead of a potash soap. This seems to indicate that there was a difference in the soaps,

and that potash soap was the better.

The chemical formula for soap depends on the kind of fats that go into it, but the only difference between soda and potash soap made from the same kind of fats is simply sodium in one case, and potassium in the other. So chemically there should be no difference in the reaction of the two soaps with the alum solution, so far as waterproofing the masonry is concerned. The reaction that takes place is the formation in one case of aluminium soap, and sodium sulphate, and in the other of aluminium soap and potassium sulphate. It is the aluminium soap that makes the masonry waterproof.

Though the primary object of

the investigation was to determine the relative efficiencies of soda and potash soaps in rendering brick waterproof, some experiments were made for the purpose of learning something of the necessary number of coats.

Method of Investigation.

In this investigation bricks were used, each brick being broken in two, and one half was treated with one kind of soap, and the other half was treated with the other kind of soap, or not treated at all. After the washes had been applied the brick were soaked in water, and the percentages of absorption recorded.

The proportions of soap and alum used in the following experiments were the same as

those used by Dearborn on the Croton reservoir; namely, three-quarters of a pound of soap to one gallon of water, and half a pound of alum to four gallons of water,- both being thoroughly dissolved before being used. The first or soap solution was put on while boiling hot with a flat brush, care being taken not to form a froth on the brick. This wash was allowed to stand twenty-four hours before the second, or alum solution, was put on. The alum solution was heated to a temperature of about 70° or 80° C, and was applied in the same manner as the first wash. This also was allowed to stand twenty-four hours before the second soap-wash was put on. The washes were then applied alternately

until the desired number of coats was reached.

The soda soap used was Castile, and the potash was German green soap. It was necessary to boil the castile soap in order to get the desired amount into solution. On cooling the solution thickened and hardened until it had a consistency resembling jelly or lard. For this reason it must be at a boiling heat when applied to the brick. Though the potash solution was brought to a boiling temperature in order to dissolve the soap more easily, it remained liquid on cooling.

Before being weighed all the bricks were thoroughly dried on live steam pipes which had a temperature of about 70°C. They were immersed in water, and

were weighed the second time immediately upon being taken out. In Experiment 1, the length of the brick were soaked and heated in drying, is stated in table I; but in subsequent experiments all the brick were soaked for forty-eight hours, and then dried for not less than seven days.

Experiment 1.

The object of this experiment was to learn something of the number of coats necessary to make the brick waterproof. Ordinary building brick, and a soda (Castile) soap were used. The results are given in Table I.

TABLE I.

EFFECT OF DIFFERENT NUMBERS OF COATS ON ORDINARY BUILDING BRICK .

Brick No.	Treatment	No. Coats	Weight in grammes		Gain	Diff.	Hours	Hours
			Dry	Wet	o/o	o/o	Soaked	Heated
6	Treated	1	1070.5	1151.0	7.5	0.1	24	61
	Un-		1063.0	1141.7	7.4		24	26
4	Treated	2	833.0	942.5	13.1		24	53
	Un-		792.4	906.0	14.3	1.2	24	26
2	Treated	3	1163.0	1323.5	13.8		24	44
	Un-		998.0	1149.0	15.1	1.3	24	26
3	Treated	4	1214.0	1393.0	14.7		24	45
	Un-		943.2	1104.9	17.1	2.4	24	45
5	Treated	5	1120.5	1235.5	10.3		24	43
	Un-		1031.5	1140.5	10.6	0.3	24	26
1	Treated	6	1193.0	1357.0	13.7		24	47
	Un-		967.6	1113.0	15.0	1.3	24	26
3	Treated	4	1214.0	1402.0	15.5		48	.....
	Un-		943.2	1114.0	18.1	2.6	48	.....
3	Treated	4	1214.5	1409.5	16.0		72	44
	Un-		944.5	1109.0	17.4	1.4	72	26
5	Treated	5	1120.5	1241.0	10.7		48	....
	Un-		1031.5	1143.5	10.8	0.1	48	....
5	Treated	5	1120.5	1242.5	10.8		72	....
	Un-		1031.5	1145.0	11.0	0.2	72	....
5	Treated	5	1120.5	1244.0	11.0		96	....
	Un-		1031.5	1146.0	11.1	0.1	96	....
5	Treated	5	1120.5	1249.0	11.4		168	....
	Un-		1031.5	1152.5	11.7	0.3	168	....
5	Treated	5	1120.5	1251.0	11.6		216	....
	Un-		1031.5	1155.0	11.9	0.3	216	....

From the small differences in the percentages of absorption, it seems that ordinary brick are too porous for this kind of treatment. For this reason pressed brick were used in the rest of the experiments, but as will be seen later the results were much the same. The difference in percents of absorption in the above experiment was apparently not effected by the length of time of soaking. Two or three coats seemed to be most effective

Experiment 2.

Pressed brick, and a soda (Castile) soap were used. The object of this experiment was to find the number of coats most effective.

TABLE II.

EFFECTIVENESS OF DIFFERENT COATS ON PRESSED BRICK.

Brick No.	Treatment	No. of Coats	Weight in grammes		Gain	Gain	Diff.
			Dry	Wet	gr.	o/o	o/o
1	Sodium	1	1124.3	1189.6	65.3	5.81	
	Untreated		1630.0	1771.7	141.7	8.69	2.88
2	Sodium	2	1326.6	1389.2	62.6	4.72	
	Untreated		1341.4	1450.3	108.9	8.12	3.40
3	Sodium	3	1324.0	1406.9	82.9	6.26	
	Untreated		1386.5	1484.4	97.9	7.06	0.80
4	Sodium	4	1364.8	1454.2	89.4	6.55	
	Untreated		1336.5	1433.7	97.2	7.27	0.72
5	Sodium	5	1308.8	1402.7	93.9	7.17	
	Untreated		1312.7	1420.2	107.5	8.19	1.02

Here again two coats seem more effective than more. The small differences in the per cents of absorption are again noticeable.

Experiment 3.

This experiment is the same as Experiment 2, except that potash soap was used instead of soda soap.

TABLE III.

EFFECTIVENESS OF DIFFERENT COATS ON PRESSED BRICK.

Brick No.	Treatment	No. of Coats	Weight in grammes		Gain		Diff.
			Dry	Wet	gr.	o/o	o/o
1	Potassium	1	1506.7	1604.2	97.5	6.47	
	Untreated		1312.2	1399.0	86.8	6.61	0.14
2	Potassium	2	1273.3	1345.8	72.3	5.68	
	Untreated		1445.3	1547.8	102.5	7.09	1.41
3	Potassium	3	1480.1	1576.2	96.1	6.49	
	Untreated		1149.8	1238.0	88.2	7.67	1.18
4	Potassium	4	1061.0	1143.4	82.4	7.78	
	Untreated		1586.2	1722.5	136.3	8.59	0.81
5	Potassium	5	1391.3	1489.6	98.3	7.06	
	Untreated		1258.6	1352.4	93.8	7.45	0.39

The differences in the per cents of absorption are again small, and the bricks having two and three coats absorbed less water than did the others. Comparing the results in the last column of the above experiment with those in the same column in the second experiment, it seems that the soda soap is more efficient than the potash soap. The differences are so slight, however, that such a conclusion might not be justifiable.

Experiment 4.

As the potash solution remains liquid on cooling, the following experiments was made to see whether or not anything was gained by applying the solution at a boiling temperature. In the preceding experiments the solutions were applied hot

while in this bath the soap and the alum solutions were applied cold.

TABLE IV.

EFFECT OF COLD SOLUTIONS.

Brick No.	Treatment	No. of Coats	Weight in grammes		Gain		Diff.
			Dry	Wet	gr.	%	%
1	Potassium	1	926.5	989.1	62.6	6.76	
	Untreated		1756.1	1876.7	120.6	6.86	0.10
2	Potassium	2	1573.1	1677.7	104.6	6.65	
	Untreated		1116.1	1204.2	88.1	7.89	1.24
3	Potassium	3	1223.9	1297.2	73.3	5.98	
	Untreated		1557.3	1658.9	101.6	6.52	0.54
4	Potassium	4	1301.8	1379.2	77.4	5.94	
	Untreated		1373.3	1463.1	89.8	6.54	0.60
5	Potassium	5	1200.1	1258.2	58.1	4.84	
	Untreated		1587.4	1681.9	94.5	5.95	1.11

Comparing the results above with those in the previous table, it seems that there is a slight advantage in heating the solutions. The difference as shown by the two experiments, however, is not as marked as one would expect.

Experiment 5.

The object of this experiment was to make a direct comparison between soda and potash soaps. As a single brick is more or less likely to be of uniform density, the two soaps were applied to the halves of the same brick. Both applications were made in the same manner, and the two halves

were submitted to the same treatment, so that the difference in the per cents of absorption was, as far as possible, due wholly to the difference in the soaps.

TABLE V.

COMPARATIVE EFFECT OF SODA AND POTASH SOLUTIONS.

Brick No.	Treatment	No. of Coats	Weight in grammes		Gain		Diff.
			Dry	Wet	gr.	o/o	o/o
1	Sodium	1	1295.3	1363.9	68.6	5.29	0.18
	Potassium	1	1428.8	1501.8	73.0	5.11	
2	Sodium	2	1391.5	1461.6	70.1	5.04	0.10
	Potassium	2	1384.0	1452.4	68.4	4.94	
3	Sodium	3	1295.3	1368.1	72.8	5.62	
	Potassium	3	1425.5	1506.8	81.5	5.72	0.10
4	Sodium	4	1281.5	1343.6	62.1	4.85	0.10
	Potassium	4	1418.3	1485.7	67.4	4.75	
5	Sodium	5	1308.1	1376.0	67.9	5.19	
	Potassium	5	1424.1	1499.4	75.3	5.29	0.10
6	Sodium	6	1284.7	1359.7	75.0	5.83	
	Potassium	6	1484.4	1573.0	88.6	5.96	0.13

The results of the experiment indicate that there is practically no difference in the two soaps. The difference in the per cents of absorption is small in each case, and is in favor first of one soap, and then the other, so that the difference may easily be attributed to experimental error.

General Conclusions.

One point in favor of the potash soap is that if necessary it may be applied cold.

There is no appreciable difference in the effect of the two soaps on the absorptive power of masonry.

As to the coloring effect on the masonry, each soap left a

slight white deposit on the surface of the brick. This was more noticeable with the soda soap. It was due perhaps to the fact that the soda solution is not as liquid as the potash, thus more of it remains on the surface to react with the alum solution.

Apparently two coats are more effective than a greater number. This conclusion seems unreasonable but is supported by all the experiments. It does not seem possible that the anomaly is the result of difference in manipulation. As the several coats were applied in the same and at the same time, and the weighing was carefully done upon the same scales, the writer is unable to offer any plausible explanation.

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